Chapter V

Online Collaborative Learning in Mathematics: Some Necessary Innovations

Rod Nason
Queensland University of Technology, Australia

Earl Woodruff
OISE - University of Toronto, Canada

ABSTRACT
This chapter discusses why computer supported collaborative learning (CSCL) environments have been unsuccessful in facilitating knowledge building in mathematics. It identifies two of the major reasons why this is so and suggests these issues could be overcome by the inclusion of model-eliciting mathematical problems and comprehension modeling tools within CSCL environments. Theoretical frameworks to inform the design of these two types of artifacts are presented. The authors argue that such innovations in the design of CSCL environments are necessary for students to achieve in mathematics the kind of sustained, progressive knowledge building that can now be found in other subject areas.
INTRODUCTION

One of the most promising pedagogical advances for online collaborative learning that has emerged in recent years is Scardamalia and Bereiter’s (1996) notion of knowledge-building communities. In knowledge-building communities, students are engaged in the production of conceptual artifacts (e.g., ideas, models, principles, relationships, theories, interpretations, etc.) that can be discussed, tested, compared, hypothetically modified and so forth, and the students see their main job as producing and improving such artifacts, not simply the completion of tasks (Bereiter, 2002a).

Anecdotal evidence from teachers using computer supported collaborative learning (CSCL) environments, such as Knowledge Forum\(^1\) and its predecessor CSILE, and from formal evaluation studies indicates that computer-mediated knowledge-building communities are excellent for nurturing collaborative learning and communities of practice in subject areas such as social studies, art, history, geography, language arts and science (Bereiter, 2002a; Scardamalia & Bereiter, 1996). However, establishing and maintaining knowledge-building communities of practice with Knowledge Forum (and other CSCL software environments such as CSILE) in the domain of mathematics has been found to be a rather intractable problem (Bereiter, 2002a; De Corte, Verschaffel, Lowyck, Dhert, & Vanderput, 1999; Nason, Brett, & Woodruff, 1996; Scardamalia & Bereiter, 1996).

In this chapter, we begin by identifying two major reasons why computersupported knowledge-building communities in mathematics have been difficult to establish and maintain:

1. Inability of most “textbook” math problems to elicit ongoing discourse and other knowledge-building activity either during or after the process of problem solving.
2. Limitations inherent in most CSCL environments’ math representational tools and their failure to promote constructive discourse or other mathematical knowledge-building activities.

Therefore, we argue that if mathematics education is to exploit the potentially powerful new ways of learning mathematics being provided by online knowledge-building communities. Then, the following innovations need to be designed and integrated into CSCL environments:

1. Authentic mathematical problems that involve students in the production of mathematical models that can be discussed, critiqued and improved, and
2. Comprehension modeling tools that: (a) enable students to adequately represent mathematical problems and to translate within and across representation modes during problem solving, and (b) facilitate online student-student and teacher-student hypermedia-mediated discourse.
Related Content

Implementing Unconventional Virtual Environments for Enhancing Creativity in Architecture Pedagogy
www.irma-international.org/article/implementing-unconventional-virtual-environments-enhancing/74840/

Collaborative Process Analysis Coding Scheme (CPACS): Examining the Macro- and Micro- Level of Students’ Discourse in a Virtual World
www.irma-international.org/article/collaborative-process-analysis-coding-scheme/78508/

Adoption of Second Life in Higher Education: Comparing the Effect of Utilitarian and Hedonic Behaviours
www.irma-international.org/article/adoption-second-life-higher-education/78507/

Mobile App to Support Teaching in Distance Mode at Fiji National University: Design and Evaluation
www.irma-international.org/article/mobile-app-to-support-teaching-in-distance-mode-at-fiji-national-university/210433/

Usability Evaluation of an Adaptive 3D Virtual Learning Environment
www.irma-international.org/article/usability-evaluation-adaptive-virtual-learning/76371/